CONTRACT FILE

Report of Progress for January, 1959

ELECTRONIC RECTIFIER STUDY

SPO 71334

Progress on the Electronic Rectifier Study during the month of January was satisfactory. Efforts were directed to completion of the rectification equations, investigation of methods of computing the corrections and study of possible methods of mechanizing the input and output transducers.

On January 7, 1959, [redacted] visited the [redacted] to discuss their ultrasonic light modulator and its possible application to the rectifier as an output light transducer.

We spoke with [redacted] Engineering; and [redacted] Chief Engineer, Electronic Section.

The ULM is a device that modulates the intensity of light passing through it in response to an input voltage. The ULM consists of a rectangular glass cell which is filled with a mixture of water and alcohol. A piezoelectric transducer is submerged in this fluid. A beam of light from an external source is directed through the cell. When a modulated carrier signal is applied to the transducer, the light passing through the cell is modulated in a similar manner as a result of diffraction effects due to the pressure wavefronts.

The main advantages of the ULM are:

1. Very high bandwidth (over 10 megacycles).
2. High light output. Since the light source is external, an arc lamp can be used if required.

3. Good linearity of light output with input voltage.

4. Very good tonal range capability.

Another possibility as an output light transducer is a glow modulator tube. These units are extremely simple and cheap but have low light output and limited frequency response. They do not seem to be used above 1 megacycle. If reliable data on their upper frequency limit cannot be found, we will run tests to determine it. Other light modulators are being investigated.

Because high resolution films are usually very slow, we may have to use the ULM to get enough light for proper exposure.

STATINTL

STATINTL

We also spoke with [redacted] showed us the rectifier that they are building for Rome Air Development Center. Unfortunately, the unit was not complete and we did not see it operate. Because of certain of its design features, this unit would be completely unsuitable for the purposes of this study.

STATINTL

STATINTL

On January 13-14 [redacted] attended the Cathode Ray Tube Recording Symposium in Dayton, Ohio. This symposium was sponsored by the [redacted] to discuss the problems involved in the use of high resolution CRT's for photographic recording. The sessions were very informative, and such subjects as resolution obtainable, spot-size measurements, matching of photographic and video parameters, and films available for this work were discussed. Copies of the papers are available.

STATINTL On January 12 [redacted] met with the customer in Washington, D. C., to discuss fiscal matters.

STATINTL On January 29 [redacted] met with the customer in Washington to discuss progress. The December progress report was presented and discussed. The September-October report, which had been prepared in response to the customer's request of January 12, was also discussed.

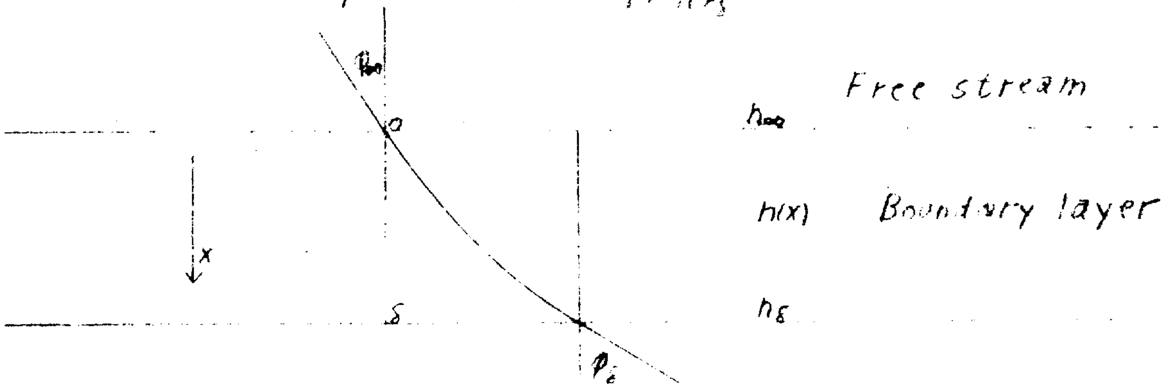
Expenditures through January total [redacted] or 58% of the total price. STATINTL Progress appears to be commensurate with this figure.

The following mathematical appendix discusses the effects of plane glass plates and boundary layers.

Correction

In the [redacted] report #SM-14377 by [redacted] on the deflection of a light ray by the boundary layer of air moving past a rapidly moving aircraft, it was considered that the velocity distribution was a function of the normal distance from the skin only and this distribution was in plane parallel layers. It was considered that if φ_∞ was the angle at which the ray enters the boundary layer and φ_δ, the angle at which the ray leaves the layer, then Snell's law holds so that

$$\frac{\sin\varphi_\delta}{\sin\varphi_\infty} = \frac{n_\infty}{n_\delta} = \frac{1+k\rho_\infty}{1+k\rho_\delta} \quad \text{(see figure)}$$



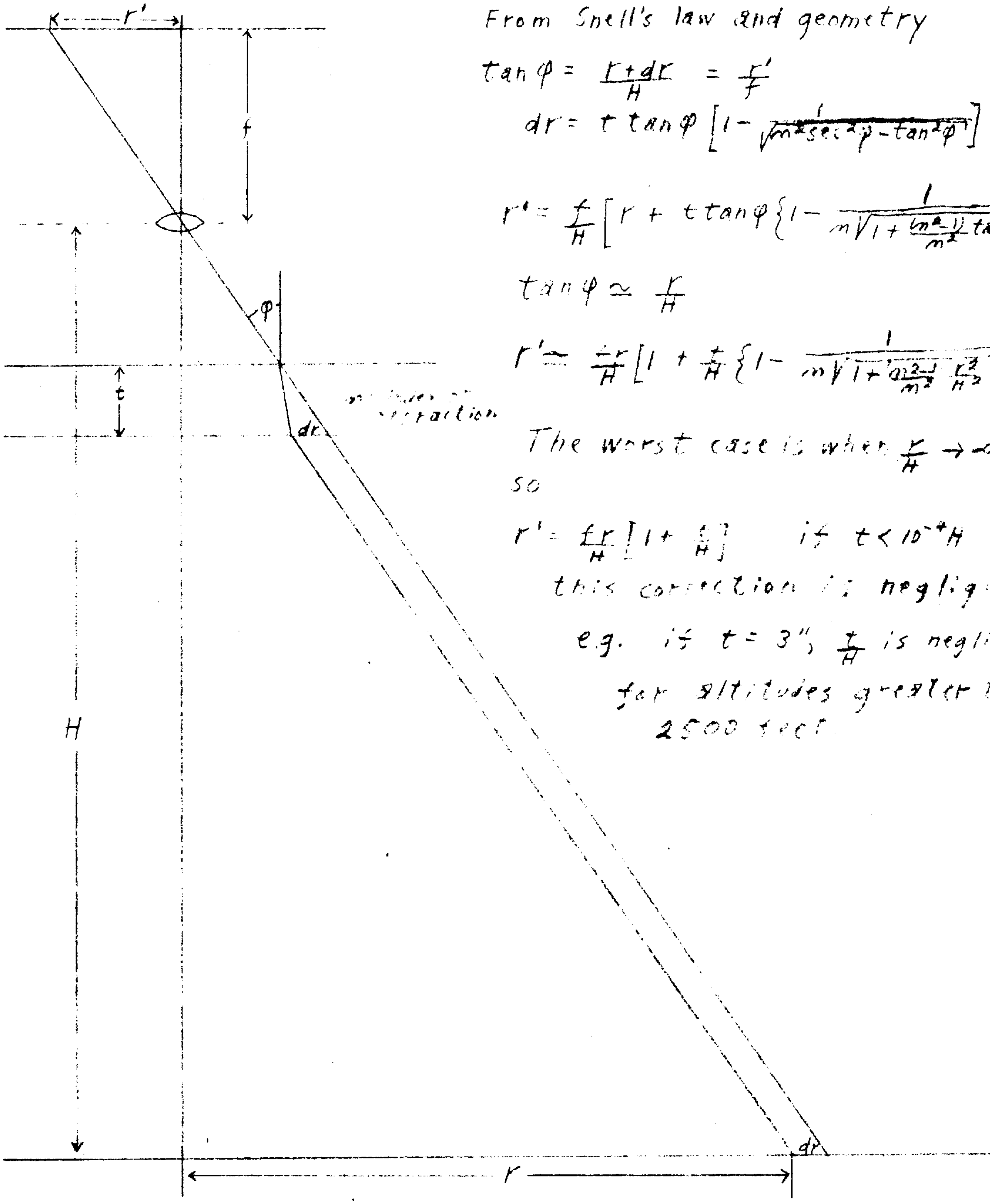
STATINTL

From aerodynamic considerations and the perfect gas law [redacted] says

$$\frac{\rho_\delta}{\rho_\infty} = \left[1 + \left(\frac{\gamma-1}{2}\right)\alpha M_\infty^2\right]^{-1}$$

where γ is the ratio of specific heats, α is a constant related to the Prandtl number and M_∞ is the free stream Mach number. From this he calculates the angle of deflection $\epsilon = \varphi_\delta - \varphi_\infty$ and plots $\frac{\epsilon}{\tan\varphi_\infty}$ as a function of M_∞ and altitude. However, if in addition the ray goes through a plane glass plate in order to enter the craft, the final direction of the ray will depend only on the free stream refractive index and that inside the aircraft. If the inside temperature and pressure are equal to that of the free stream, there will be no angular deflection.

Correction for Thickness of a Glass Plate



From Snell's law and geometry

$$\tan\varphi = \frac{r+dr}{H} = \frac{r'}{f}$$

$$dr = t\tan\varphi\left[1 - \frac{1}{\sqrt{m^2\sec^2\varphi - \tan^2\varphi}}\right]$$

$$r' = \frac{f}{H}\left[r + t\tan\varphi\left\{1 - \frac{1}{m\sqrt{1+\frac{(m^2-1)}{m^2}\tan^2\varphi}}\right\}\right]$$

$$\tan\varphi \simeq \frac{r}{H}$$

$$r' \simeq \frac{fr}{H}\left[1 + \frac{t}{H}\left\{1 - \frac{1}{m\sqrt{1+\frac{m^2-1}{m^2}\frac{r^2}{H^2}}}\right]$$

The worst case is when $\frac{r}{H} \to \infty$ so

$$r' = \frac{fr}{H}\left[1 + \frac{t}{H}\right] \qquad \text{if } t < 10^{-4}H$$

this correction is negligible

e.g. if $t = 3''$, $\frac{t}{H}$ is negligible for altitudes greater than 2500 feet

Approved For Release 2002/06/17 : CIA-RDP78B04747A000600080056-7

Corrections to December report

p. 12, Eq. 16, 3rd order term, right side

$\frac{\delta_p^3}{8} \tan^4\psi(3+5\tan^2\psi)$ for $\frac{\delta_p^3}{24} \tan^4\psi(7+15\tan^2\psi)$

p. 13, Eq. 20 1st line 3rd order term

$\frac{\delta_p^3}{8} u'^4(3+5u'^2)$ for $\frac{\delta_p^3}{24} u'^4(7+15u'^2)$

same 2nd line, beginning $-hu'([\quad]$ for $+hu'([\quad]$

" 3rd " " $-hu'([\quad]$ for $+hu'([\quad]$